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PROCESS OF ENAMELING

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This invention relates to a process of applying white porcelain enamel to a metal surface such as iron or steel.

The primary object of my invention is to provide a practical and controllable process for applying a white porcelain enamel coating directly upon iron or steel.

In the past, in applying a white finish porcelain enamel coating to iron or steel structures, it has been customary, first to apply and fuse a dark porcelain ground coat to the metal. Attempts to apply the white porcelain enamel coating directly upon the iron or steel have not been successful for generally these coatings were defective, having blister and black speck type of defects, which apparently were caused by minute quantities of gases in the iron or steel. It is not known definitely what these gases are but it is thought they may be either hydrogen or carbon monoxide or carbon dioxide, or possibly some nitrides.

As one specific example of my invention, the piece or structure which it is desired to coat with white porcelain enamel, is first heated in a non-oxidizing atmosphere of nitrogen maintained at a temperature of about 1600° F. for about one hour. The heated structure is then cooled in the same or similar atmosphere to approximately room temperature. The structure is preferably made of commercial enameling iron, but it may also be steel or other metal capable of withstanding the temperatures necessary for fusing the porcelain. This procedure prepares the metal for the porcelain coating. It is believed that gases in or formed in the iron or steel are removed by this process.

Thereafter, the metal structure is coated with a finish coat of white porcelain enamel in the usual manner. For example, the frit which is essentially an alkali borosilicate glass in granular form containing boric oxide, alumina and silica, is mixed with water, clay, and opacifiers. This mixture is ground until all particles will pass a 200 mesh screen. This mixture, usually called milled white enamel or slip, is in the form of a liquid suspension and is applied directly to the metal structure after the cooling mentioned in connection with the previous heating operation. It may be applied to the metal structure either by dipping the metal structure into the liquid suspension or by spraying or by flowing the liquid suspension onto the metal structure. This liquid suspension coating is then dried in any suitable manner.

Thereafter, the metal structure with the dried

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coating is put into a furnace having an air atmosphere maintained at a temperature of between 1500° and 1520° F. and kept therein for two minutes, so that the coating will fuse into white porcelain enamel, providing a coating which is free from defects and has a satisfactory white opaque appearance.

Other non-oxidizing, or reducing atmospheres may be used such as, for example, hydrogen, or a cracked gas containing nitrogen, hydrogen, carbon monoxide and perhaps a small amount of carbon dioxide. Carbon monoxide or carbon dioxide alone may likewise be used.

While excellent results have been obtained by maintaining the furnace atmosphere at 1600° F. for one hour, other temperatures and other periods of time might be used. If a higher temperature is used, a somewhat shorter period of time is permissible. If the lower temperatures are used a longer period of time is generally required to obtain equivalent results. In general, it does not appear desirable to perform this operation at a temperature of less than about 1400° F., no matter what length of time is used, and it does not appear desirable to reduce the period of time below 24 minutes. Preferably, 30 minutes is the minimum time.

Any suitable finish white porcelain coating material or slip may be used. The temperature and length of time of the porcelain coating operation will depend upon the particular material used. For some coatings a temperature of 1540° F. for three minutes is required.

By this process I am able to provide a smooth, satisfactory white porcelain enamel coating directly upon the usual commercial enameling iron or steel or other metal material which will be uniformly free from defeats as long as the above mentioned conditions or their equivalents are maintained. These conditions can be readily maintained with modern industrial equipment so that a whie porcelain coated product can be produced at a low cost without serious difficulty.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. The process of providing a smooth white enamel porcelain finish coating upon bare enameling iron and steel which consists in first heating the bare iron and steel in a non-oxidizing atmosphere at a temperature of at least 1400° F. for at least a half hour to remove gases in the

iron and steel and cooling the iron and steel in a non-oxidizing atmosphere substantially to room temperature and thereafter applying a milled white porcelain enamel coating in the form of a liquid suspension directly to the surface of the bare iron and steel, drying this coating, and heating the coated iron and steel at a temperature of at least 1500° F. for at least two minutes to provide a fused white porcelain enamel coating upon the surface of the bare iron and steel.

2. The process of providing a smooth white porcelain enamel finish coating upon bare enameling iron and steel which consists in heating the bare enameling iron and steel in a nitrogen atmosphere maintained at a temperature of at least 1400° F. for at least one half hour and thereafter cooling the iron and steel in a substantially non-oxidizing atmosphere, and thereafter applying a milled white porcelain enamel coating in the form of a liquid suspension directly to the bare iron and steel and drying this coating, and heating the coated iron and steel to a temperature of at least 1500° F. for at least two minutes to provide a white porcelain enamel coating fused directly to the surface of the bare enameling iron and steel.

3. In a method of enameling in which a structure is made from commercial enameling iron, the steps consisting of heating the structure to a

temperature of at least 1400° F. in a non-oxidizing atmosphere, maintaining the structure at such temperature and in such atmosphere for a period of time between about 24 minutes and one hour until its surface has been freed from gases, gradually cooling the structure substantially to room temperature, applying directly to the surface of the structure a milled white porcelain enamel coating in the form of a liquid suspension, drying this coating, and heating the structure thus coated to a temperature sufficient to convert the coating into a coat of fused enamel.

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